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diamonds of the Brazilian fields.—In the lower greensands at Flitwick and Sandy, in Bedfordshire, England, Mr. A. G. Camero¹ has found ironstone nodules filled with water, which they lose by evaporation when left exposed to the action of dry air.

BOTANY.²

The Growth of *Tulostoma mammosum*.—This odd puff-ball, which is found upon a stalk varying from one to five inches in length, occurs in abundance in the vicinity of Lincoln. I have been much interested in watching its development,—a thing by no means as easy as for many other puff-balls. One usually finds it in the Spring, in ground which had been cultivated the previous year. It often grows in clusters or groups of from half a dozen to a dozen or more, and, upon the bare ground, in the early part of the season, just after the disappearance of the snow, they are easily found. In the summer and autumn they are much more difficult to find. Last summer I was fortunate enough to discover a few clusters just as they were developing, and noted some facts which appear to be new. The ball forms under ground, and reaches maturity there,—that is, so far as its spores are concerned. *Tulostoma* agrees with *Lycoperdon* in having the interior of the ball composed of two portions,—viz., (1) a spore-bearing part occupying most of the interior, and (2) a sterile base composed of tissue which does not produce spores. Now, in *Lycoperdon*, if one makes a vertical section of a young ball which has nearly ripened its spores, the two parts may be very easily distinguished. In some species the sterile base is quite small, occurring merely as a greater or less thickening of the boundary tissues at the base of the ball, while in others it is well developed, notably so in *Lycoperdon cælatum*.

In *Tulostoma* a portion of the tissue of this sterile base remains living until after the ripening of the spores in the ball. At this time the tissue begins a rapid growth, and, as a consequence, a cylindrical stalk is quickly produced. This forces the ball through the overlying earth, and sometimes carries it up several inches. This sudden formation of the stalk reminds one of the similar growth of the stalk in the *Phalloideæ*, to which, indeed, as is well known to mycologists, *Tulostoma* is distantly related.

The stalk of *Tulostoma* (of this species, at least) never develops while the ball is immature. One never finds young balls upon a stalk. In fact, I have, as yet, not succeeded in finding any balls in which the spores were not well developed. This, of course, is due to their subterranean habit. I doubt not, however, that the details of their early development are essentially like

¹ Geol. Magazine, August, 1886, p. 381.

² Edited by Prof. CHARLES E. BESSEY, Lincoln, Nebraska.

those of other puff-balls. Their greatest difference is that just pointed out, whereby the sterile base develops a stalk after the ball has matured its spores.—*Charles E. Bessey.*

Ash-Rust again.—It will be remembered that I called attention, two years ago, to the great abundance of the Ash-Rust (*Æcidium fraxini* Schwein) upon the Green Ash (*Fraxinus viridis*) in Lincoln. Last year I noted the fact that this rust was very rare in the same locality. This year the rust is, if anything, still more rare than last year. I have seen scarcely any leaves affected by it, and have had but few specimens brought to me by a large class of efficient student collectors. It is difficult to suggest an adequate explanation of the sudden disappearance of what threatened in 1885 to be a very serious pest to the Green Ash. The trees were badly affected in 1884 also, as I noticed about the 1st of July, while on a visit of a few days to the city. I have no data earlier than that year. The record thus far is as follows: 1884 and 1885, ash-rust abundant; 1886 and 1887, ash-rust rare.—*Charles E. Bessey.*

Vitality of Buried Seeds.—On May 25, 1886, I buried the following seeds five feet deep in light, sandy soil, at Grand Rapids, Mich.: white oats, common white beans, Stowell's evergreen sweet-corn, Hathaway dent-corn, and buckwheat. All were grown in 1885, and had percentages of germination in good, sandy garden-soil varying from 87 to 94. One hundred seeds of each were mixed with sand and placed in separate, open, tin cans, with the openings downward. On May 22 of this year (1887) I had them examined. All were dead. A little of the sweet-corn had sprouted; most of the dent-corn had grown about three inches in length, having roots that filled the can. The other seeds had decayed without germinating.—*A. A. Crozier, Department of Agriculture, Washington, D. C., June 3, 1887.*

The Study of Lichens.—"To the American student the study of lichens presents peculiar difficulties. Some of these are (1) the want of any work containing the descriptions of all known lichens; (2) the difficulty of procuring the works upon lichens, and the fact that they are mostly in foreign languages,—Latin, German, French, etc.,—and that many useful works are published in the proceedings of learned societies, and are not to be consulted here; (3) the embarrassment arising from the multiplicity of systems, and the differences of opinion as to the limits of genera and species; (4) the vast synonymy, which renders it often difficult to decide as to the proper name of a plant; (5) the extent and variety of our own lichen-flora, and the incompleteness of the work of our great authority, Tuckerman."

The foregoing quotation is from an interesting little work, entitled "An Introduction to the Study of Lichens," by Henry Willey, of New Bedford, Mass., which is intended to help the beginner over some of the above-mentioned difficulties, as well as to lay a broad foundation for good work. Five pages of the book are devoted to the collecting and preservation of lichens. Ten pages are given to the structure and organs of lichens; two and a half to the distribution of North American lichens; four to the history of lichens; two to bibliography; and twenty-eight to their systematic arrangement. The ten plates which are added will be very helpful to the student.

A slip of the pen, which can easily be corrected, occurs on page 11, where a lichen is said to be "a cryptogamic plant of the order [*sic*] Thallophytes." Class, or Branch, was evidently intended. In the fifth chapter it would have been well, perhaps, to have referred to a distribution of sets of New England lichens begun eight or ten years ago by Dr. Halsted, but soon abandoned. Reference should also have been made to the excellent introduction to the study of the structure and development of lichens in Sach's "Text-Book of Botany," Goebel's "Classification of Plants," and the article "Lichens," by the Rev. James M. Crombie, in the fourteenth volume of the ninth edition of the "Encyclopædia Britannica."

Cannot the botanists of the country prevail upon Mr. Willey to undertake the task of preparing sets of North American lichens? There can be little doubt as to the success of such an undertaking.—*Charles E. Bessey.*

Botanical News.—The "List of Works on North American Fungi," published in the *Harvard University Bulletin*, No. 37, by Professors Farlow and Trelease, is a most valuable aid to the student of the fungi. The list extends from A to H, and already includes three hundred and thirty-eight entries. The remainder is promised soon.—A book which will prove useful in the herbarium is announced by Merzbach & Falk, Rue des Paroisiens, 18, 20, 22, Brussels. It bears the title of "Index Generum Phanerogamorum," and will form an octavo volume of about six hundred and fifty pages. The subscription-price is twenty francs.—A new journal, the *Annals of Botany*, is announced in England. It "will resemble the well-known *Quarterly Journal of Microscopical Science*," and will be printed and published by the Clarendon Press, Oxford. Many eminent English botanists have given the project their support, and in this country the names of Professors Gray and Farlow appear as promising their support. The subscription-price will be twenty-one shillings per volume.—From the *Bulletin of the California Academy of Sciences* we have a paper by Dr. C. C. Parry on the Pacific Coast Alders, and one by Professor E. L.

Greene, entitled "Studies in the Botany of California and Parts Adjacent."—Dr. Halsted's *Bulletin of the Iowa Agricultural College*, from the Botanical Department, contains many things of interest, from methods of work and study in the class-room and laboratory to scientific descriptions of species.—Dr. Vasey has recently issued a pamphlet of sixty-three pages on the "Grasses of the South." It forms Bulletin No. 3 of the Botanical Division of the Department of Agriculture at Washington. Aside from its high value to the agriculturists of the South, it possesses a good deal of botanical interest.—The weeds of Southwestern Wisconsin have been listed and discussed by L. H. Pammel in a twenty-page pamphlet, which has just appeared.

ZOOLOGY.

Radiolaria.—By far the most important contribution to our knowledge of the Protozoa within recent years is the report on the Radiolaria of the "Challenger" expedition, just published by Professor Ernst Haeckel, of Jena. A summary of these nearly two thousand pages and one hundred and forty quarto plates is impossible. We can but indicate something of their scope. Professor Haeckel now restricts the limits of the Radiolaria more than formerly. As he now defines them they are "Rhizopoda with central capsule and calymma," for, as he says, their most important character is the fact that the unicellular body is always in two main portions, an inner central nucleated capsular and an extra-capsular non-nucleated portion, the calymma, the two being separated by a capsule-membrane. The majority have a skeleton, usually of silica, but frequently of organic substance (acanthin), and this may take the most beautiful shapes imaginable. The present report embraces not only the Radiolaria taken by the "Challenger" collections, but is a complete monograph of all known species, and has employed Professor Haeckel's time for ten years. The classification now adopted varies considerably from that of his monograph "Die Radiolarien" of 1862. It divides the group or class into two sub-classes.

Sub-Class I.—**Porulosa.** Central capsule primitively a sphere, and retains this homaxon form in the majority of species. The membrane of the central capsule is everywhere perforate, but possesses no larger osculum. The pseudopodia radiate in all directions, and in great numbers, passing through the openings in the capsular membrane. To this sub-class belong two legions,—1, Peripylea, or Spumellaria, with six orders, and, 2, Actipylea, or Acantharia, with four orders.

Sub-Class II.—**Osculosa.** Central capsule originally monaxon (ovoid or spheroidal), retaining this condition in most species. The membrane of central capsule with a single large osculum at the base of its vertical main axis. Pseudopodia radiating from the sarcode streaming from the osculum. This also contains